Adjusting Input-Output Models for Capacity Utilization in Service Industries

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ABSTRACT

The Input-Output (I-O) models assume the stability of economic ratios and regional multipliers over the evaluation period. For manufacturing sectors, constant multipliers within a short-term period may present a reasonable picture of the real-world production function. Tourism industry, however, is composed of a variety of services in which total output and factor inputs are strongly influenced by capacity utilization (CU). A conceptual model is proposed in this paper which purports that shifts in CU for perishable services will lead to economies of scale in inputs, price changes in the final output, capacity constraint on domestic supply and substitution between input factors, especially between capital and labor. These factors simultaneously modify I-O ratios and multipliers. Traditional I-O analysis, which assumes constant economic ratios and multipliers, will therefore lead to biases in tourism impact estimates, especially to value added components, as it does not reflect the changing costs of operation in response to shifting supply and demand.

Keywords: Input-Output analysis, capacity utilization, tourism multipliers, services
1. Introduction

Since the 1970’s, Input-Output (I-O) analysis has been used extensively to evaluate the economic impacts of tourism (Archer, 1977, 1978, 1984; Fletcher, 1989). Advantages of I-O analysis are 1) its flexibility to evaluate economic impacts from the general equilibrium perspective based on different temporal and spatial scales, 2) its ability to monitor the economic impacts of individual groups who have distinct spending patterns, and 3) the ease of interpretation and convenience of data availability (Blake, 2000; Briassoulis, 1991; Fletcher, 1989). Although in recent years, Computable General Equilibrium (CGE), the more complex and powerful economic model, has been strongly promoted and adopted at the national level (Dwyer, Forsyth, Madden, & Spurr, 2000; Dwyer, Forsyth, & Spurr, 2004), regional analysis of tourism economic impacts is still primarily constructed based upon the I-O framework.

Input-Output analysis computes tourism’s economic impacts by first converting the final demand changes (e.g., visitor spending) into direct effects in terms of jobs, personal income, taxes and value added\(^1\) using economic ratios for the regional economy. Secondary effects resulting from the inter-industry dependencies are then computed by multiplying the direct effects by regional multipliers. The accuracy of the I-O analysis relies on three factors: 1) the stability of the economic ratios, such as jobs, personal income and value added to sales ratios from the survey year\(^2\), 2) the stability of regional multipliers (type I

\(^1\) The value added component is defined as the sum of personal income, rents, profits and indirect business taxes.

\(^2\) Input-Output table illustrates the economic structure of a specific region in a year (referred to as the base year or the survey year in this paper). Generally, there is a time difference between the year represented by the
and type II sales multipliers) from the survey year, and 3) the estimation of final demand changes, such as visitor spending or government investment.

Three principal assumptions employed in an I-O analysis are 1) the output of each sector is produced with a unique set of inputs, 2) the amount of input required is solely determined by the level of output, and 3) there are no capacity constraints in the production process (Miller & Blair, 1985; Otto & Johnson, 1993). Based on these assumptions, economic impacts are solely determined by final demand changes. In other words, I-O models assume that economic ratios and regional multipliers are stable from the year of the I-O table through the evaluation period (typically within 2 to 5 years). Constant technical coefficients and fixed economic ratios of labor cost, employment, and profitability are applied when calculating total impacts, regardless of the level of demand or supply capacity.

A sector, for example, operating at 40% capacity is assumed to have the same cost structures and productivity as one operating at 80% capacity. For manufacturing sectors, constant economic ratios, such as jobs to sales ratios, and regional multipliers within a short-term period may provide a satisfactory portrayal of the real-world production function and offer estimates with acceptable errors (West, 1995). Tourism, however, does not occur within the framework of a single acknowledged industrial sector (Fletcher, 1989; Smith, 1994). The tourism industry is perceived as a combination of sectors and primarily offers services that are time perishable, such as lodging, entertainment, and transportation. These services have distinct characteristics such as simultaneity and perishability in their

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I-O table and the time when the evaluation takes place. The economic structure of the region may have experienced changes during this time.
production and consumption process. Specifically, capacity utilization (CU), defined as the ratio of actual used (consumed) products to the total available products, is a distinct measure for services to explain changes in the rate of investment, labor productivity and price of services (Berndt & Morrison, 1981).

Relatively few tourism studies have examined the stability of multipliers and economic ratios from the perspective of CU. Archer (1977), Bryden (1973), West (1995) and Crompton (1995) have questioned the stability of jobs to sales ratios in the I-O framework, suggesting that I-O analysis will generally leads to overestimation of jobs and personal income in tourism applications. The argument for overestimation is that when surplus capacity exists, an increase in demand can be absorbed without a proportional increase in employment or intermediate goods. Instead, an increasing profit level is observed. In the example of the Grand Prix car racing event in Australia, Hutch (1986) found that no new permanent jobs were generated in the transportation sector as a result of the Grand Prix. Moreover, for some operations, the workload was rearranged so that even overtime pay was not required. Hatch (1986) concluded that higher profits and value added are expected at higher utilization levels rather than additional jobs.

Bryden (1973) was the first to present the quantitative differences among hotel revenue and cost structures at different utilization (occupancy) rates. He used financial data from a single hotel in Antigua to simulate hotel revenue and cost structures at a 45% versus a 65% occupancy rate. By assuming constant price indices in the hotel operation and fixed I-O technical coefficients for the rest of the economy, Bryden (1973) demonstrated that the value added multipliers of the hotel sector decreased from 0.684 at a 31% occupancy rate to 0.644 at 65%. The personal income multipliers decreased from 0.490 at a 31% occupancy
rate to 0.443 at 65%, and the gross profit multipliers increased from 0.194 to 0.201. The decreasing value added multiplier effect was primarily due to the interaction of increasing import content and decreasing labor costs as demand rose. These results supported Bryden’s (1973) statement that “the assumptions regarding utilization of capacity are likely to be important in determining the input-output coefficients in the hotel industry” (p. 126).

Although Bryden’s (1973) study was pioneering in studying structural stability and capacity utilization, a conceptual framework that considers the unique characteristics of services within the input-output frameworks has not been explicitly addressed. The direction and magnitude of potential biases in using standard I-O models in the tourism context also have not been discussed from the perspective of economies of scale.

Therefore, the purposes of this paper are to examine factors that are directly influenced by capacity utilization in the I-O framework and to discuss the associated biases when standard I-O models are applied to tourism service sectors under distinct levels of capacity utilization.

The set-up of this paper is as follows: the unique characteristics of perishable services are examined first, followed by a discussion of how these factors are related to capacity utilization and cost structures of service business. The direction of estimation biases due to economies of scale under standard I-O models is discussed. In the second section, a case study of Taiwan tourist hotels is used to demonstrate the changes in job and income ratios and related multipliers under different capacity utilization rates (occupancy rates). This example illustrates the scale of differences between standard and recomputed

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3 In this paper, the scope is delimited to service sectors that are directly related to the tourism industry, including hotel, restaurant, entertainment, recreation experience providers and transportation.
multipliers. The last section provides implications and conclusions regarding capacity utilization and the use of I-O analysis in a tourism context.

2. Characteristics of perishable products

Capacity utilization (CU) can be viewed as the ratio of actual consumed outputs to some measure of potential output (Nelson, 1989; Ng, Wirtz, & Lee, 1999). Potential output refers to 1) the maximum output that may be produced given a firm’s short-run stock of capital, or 2) the output based on the economic measurements using the long-term or short-term total cost curve (Nelson, 1989). This concept is particularly important for certain tourism products/services, such as the lodging, amusement, and transportation sectors, due to their fundamental characteristics in the production and consumption process. The main characteristics of these services are first simultaneity and perishability. Simultaneity implies that the production and consumption of services occur at the same point in time and space. Unlike manufacturing goods, unused products (e.g., hotel rooms or airline tickets) cannot be stockpiled and resold somewhere else. The associated sales are lost forever, a realization of perishability.

Second, high fixed costs are incurred in the production process regardless of the demand level (Kimes, 1989; Lewis & Chambers, 1989). The marginal cost for offering an additional unit is relatively low up to the existing capacity. Therefore, the operational objective is to maximize profits instead of minimizing costs (Berman, 1994). One approach to generate maximum profits is through price discrimination in which the price is determined based on different demand levels and unused capacity (Arenberg, 1991; Kimes, 1989). In other words, higher prices are charged at higher levels of capacity utilization or
discounts are given when there is excess capacity. Accommodation and air transportation are the two industries that frequently practice this pricing strategy (yield management). Due to high fixed capacity in the short-run and product perishability, the profit level of many service firms is greatly tied to capacity utilization (Allen, 1988).

The third general character of service industries is that they are labor and capital intensive. Instead of maximizing the production efficiency on intermediate inputs, accommodations and restaurants tend to make best use of existing labor to accommodate additional demand (Smeral, 2003). West (1995) indicated that “service-type industries are better able to support an increase in tourist activity largely within existing resources, whereas manufacturing-type industries, which have more rigid production structures, respond in a manner closer to that of the Leontief production system” (p.223). It can be inferred from West’s research that, in service sectors, production costs do not rise in direct proportion to sales when demand increases because certain level of outputs can be accommodated by better use of the existing work force. This also implies that the level of employee expansion would depend upon the current utilization of existing workers. The lower the utilization, the fewer additional workers would be needed in response to a demand increase.

Due to the fundamental characteristics of perishability, intangibility and simultaneity, cost structures of service sectors are strongly influenced by the number of units consumed (sold), instead of the number of units that can be produced. The shifting cost structure with utilization levels will subsequently lead to different economic impacts, as demand for input materials from other sectors is modified due to changes on factor endowment on the production process.
The next section will examine the relationships between capacity utilization and the I-O model in great detail. Factors that influence the production function at different levels of operating capacities include 1) the price effects regarding material cost, labor wages, and final outputs, 2) economies of scale in factor inputs, 3) substitution between labor and capital, and 4) capacity constraints in the production process (Armstrong & Taylor, 2000; Bryden, 1973; Fletcher & Snee, 1989; Miller & Blair, 1985; Porter, 1999; West & Gamage, 1997).

2.1 Capacity utilization and Leontief technical coefficients

The heart of I-O analysis lies in the input-output coefficients, which describe the inter-relationships between industries for the regional economy. The stability of I-O coefficients are mainly determined by three factors: price changes, technological changes (TC), and trade patterns (West, 1995). The influence of price movements and technological changes on the I-O structure can be directly evaluated through the price-flex model proposed by Moses (1974). His model indicated that outputs in the I-O table are generally expressed in value terms, which can be further distinguished in terms of price and physical quantity. Demonstrated in Equation 1, each value coefficient in the I-O table is the underlying physical input coefficient multiplied by a relative price ratio of input material and final product.

\[
X_j = Q_j * P_j \\
X_{ij} = q_{ij} * Q_j * P_i \\
\alpha_{ij} = \frac{X_{ij}}{X_j} = \frac{q_{ij} Q_j P_i}{Q_j P_j} = q_{ij} \frac{P_i}{P_j} \tag{1}
\]
Where

\[ X_j = \text{Output (sales) of sector j} \]

\[ X_{ij} = \text{Output (sales) of sector i required to produce output of product j} \]

\[ Q_j = \text{Quantity of product j} \]

\[ P_i = \text{Price of product i} \]

\[ P_j = \text{Price of product j} \]

\[ \alpha_{ij} = \text{Technical input coefficient, output of industry i that is bought by the industry j to support on one unit production of product j} \]

\[ q_{ij} = \text{Physical input coefficient, physical output of industry i required to produce a physical unit output of industry j} \]

Traditional I-O analysis assumes that the physical input coefficients \((q_{ij})\) remain constant and the price ratio between inputs and the final product is unchanged over the policy span. These assumptions may not be accurate for service sectors, which tend to respond to demand shifts with price changes (Arenberg, 1991). Under a price discrimination strategy, the input to output price ratio in the I-O framework will fluctuate, depending upon the demand and supply conditions and the slack capacity in the base-year. This can be demonstrated through a simple example. Assuming the input coefficient for material i to product j is 0.3 for the base year, the coefficient will change to 0.25 \((=0.3*1.1/1.3)\) when price of product j increases 30% and the price of material i increases 10% for the evaluation period. For sectors that have limited technological progress, such as accommodations and restaurants, I-O technical coefficients would change primarily
depending upon the sensitivity of price ratio between input material and the final product (Hudson & Jorgenson, 1974; Moses, 1974).

“Economies of scale” may also influence the technical coefficients from the perspective of capacity utilization. Gosh (1958) points out that the matrix coefficients observed in the I-O table not only express a snapshot of the production/allocation function of an individual industry at the survey period, but also indicate how businesses perform at a given level of demand and supply. When demand is shifting in greater extent, the producers of a specific sector would then experience economies of scale (Miller & Blair, 1985). That is, as the price of input factors are fixed, the input per dollar of output falls as the scale of production increases (Lin & Lin, 2000). For example, the average cost per airline ticket is expected to be higher when business operates at 20% capacity than at 80%.

Therefore, for service sectors in the tourism industry, we propose that a shift in capacity utilization will influence the stability of the Leontief technical coefficients through price movement and economies of scales on input factors (Equation 2).

\[ \alpha_{ij} = q_{ij} \ast \frac{P_i}{P_j} \]

\[ = f(\text{economies of scale on inputs, price ratio of inputs to final product}) \quad (2) \]

Where \( \alpha_{ij} \) = technical input coefficient

\( q_{ij} \) = physical input coefficient

\( P_i \) = price of product i

\( P_j \) = price of product j

2.2 Capacity utilization and economic ratios
Factors that influence the stability of economic ratios (jobs, income and value added) in the short-term can be directly verified through the I-O formula. Assuming that production technology and trade flows remain unchanged in the short-term, jobs to sales ratios, personal income to sales ratios, and value added to sales ratios in the I-O model are determined by the following factors: price of final product, price of input material, average number of employees per (sold) final product, and the average wage (Equation 3 to 5).

**Job ratios.** The jobs to sales ratio is a function of two factors: the ratio of total sold units by total employees and the price of the final output (Equation 3).

\[
\text{Jobs to sales ratio} = \frac{\text{Total employees}}{\text{Total sales}} = \frac{\text{Total employees}}{\text{Total units sold}} \times \frac{1}{\text{Price of the final product}}
\] (3)

The first factor can be denoted as the measurement of labor efficiency, which presents the requirement of labor in supporting per unit output. When labor is not fully exercised, additional products can be offered by increasing the efficiency of existing workers either through longer working hours or higher working loads. At this instance, labor input to per unit output is reduced, representing decreasing marginal labor costs. This can be referred to as economies of scale with respect to labor. The jobs to sales ratio is also negatively correlated to the price of the final output. While both price and labor efficiency are expected to vary along with the utilization rate, the jobs to sales ratio is no longer a constant, as assumed in the traditional I-O analysis, but a variable that can be modeled endogenously.
**Personal income to sales ratio.** The personal income to sales ratio will be influenced directly by three factors: labor efficiency, output price, and average employee compensation (Equation 4).

\[
\text{Personal income to sales ratio} = \frac{\text{Total job compensation paid to the employees}}{\text{Total sales}}
\]

\[
= \frac{\text{Total employees}}{\text{Total units sold}} \times \frac{1}{\text{Price of the final product}} \times \text{Average employee compensation}
\]

\[
= \text{The jobs to sales ratio} \times \text{Average employee compensation} \quad (4)
\]

Labor efficiency and average employee compensation may not be independent of each other. It is generally recognized that labor efficiency can be achieved through the substitution of labor and capital by subsidizing workers for extra working hours/effort in the service-type industry (Krakover, 2000). Under this circumstance, compensation would be expected to increase along with the utilization rate because of additional wage subsidies. The average salary may also depend on the mix of workers that are employed. For example, an increase in occupancy rates in the accommodation sector is more likely to increase the number of low-paying jobs than higher salaried managerial personnel. A disproportional increase in lower paying jobs would not contribute positively to the reported average salary. The relationship between utilization rate and the average employee compensation is currently unclear, requiring empirical data to determine the elasticity of factor substitution.

**Value added to sales ratio.** The value added to sales ratio is determined by one minus the sum of the direct input coefficients (Equation 5). While the input coefficients are
influenced by the price movements and economies of scale on input factors (Equation 2), value added to sales ratio will be determined concurrently.

\[
\text{Value added to sales ratio} = \frac{\text{Total sales} - \text{Total cost of intermediate inputs}}{\text{Total sales}}
\]

\[
= 1 - \frac{\text{Total cost of intermediate inputs}}{\text{Total sales}}
\]

\[
= 1 - \sum_{i=1}^{n} \alpha_{ij} = 1 - \sum_{i=1}^{n} (q_{ij} \times \frac{P_i}{P_j})
\]

(5)

2.3 Capacity Constraints

Trade patterns may lead to increased adoption of imported inputs when regional supplies of domestic traded goods cannot satisfy a sudden demand expansion. Supply constraints or bottleneck conditions generally result in increasing import requirements when businesses are operating at full or near capacity. The problem was first raised by Bryden (1973), who indicated that the domestic agriculture production in Antigua could not satisfy the increasing demand from tourism developments, and therefore, a substantial increase in imported agriculture products was observed. Similar arguments were also found in O’Hagan and Mooney (1983) and Wanhill (1988).

2.4 The conceptual model

A conceptual model connecting capacity utilization and the I-O framework for services in tourism is presented in Figure 1. It hypothesizes that a shift in utilization for perishable services will lead to economies of scale on both labor and material inputs (Miller
& Blair, 1985), price changes on final output (Arenberg, 1991), substitution between input factors, especially between capital and labor (Krakover, 2000; West & Gamage, 2001), and possible capacity constraint. In other words, the pricing strategy will modify the price ratio of intermediate inputs and final output; economies of scale changes the input ratio of labor, capital, and material; the substitution pattern between labor and capital adjusts the average salary per employee; and capacity constraint on domestic supply leads to increased leakage effect. These factors simultaneously affect economic ratios, type I and type II multipliers.

2.5 An example

A hypothesized example is used in Table 1 to demonstrate changes in the cost structure by allowing output price and the labor ratios to vary. The labor ratio, in this example, is defined as the number of employees per final sold product, which can be regarded as a measure of labor efficiency. The base year cost function of the accommodation sector is presented first using the I-O coefficients from the 1999 Taiwan Input-Output table. Assuming a room price of $100, thirty-three percent of the sale will go to intermediate inputs, such as business services and manufacturing, forty-one percent will be allocated to employee compensation, two percent to imported products, and 24% to profits and taxes. In this instance, the labor efficiency equates to the number of occupied

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4 Price change may result in technical substitution between different input materials. However, it has been argued that a major swing in relative price was required before substitution took place (Rose & Miernyk, 1989).
rooms per worker. In the base year, one worker is hypothesized to support five occupied
rooms at an occupancy rate of 60%.

By allowing labor efficiency and output price to change along with occupancy rates,
the cost function and profitability, in absolute value and relative percentage, also change.
For example, if labor efficiency is improved from serving five occupied rooms per
employee to eight occupied rooms per employee, the relative ratio of required labors is
reduced per room while the ratio of input materials remain unchanged. In this instance, the
type I sales multipliers will remain unchanged but the jobs to sales ratio will decrease,
indicating that fewer jobs are supported for a given amount of hotel sales. A change in
room price, however, will affect the relative cost ratio for both intermediate inputs and
labor inputs. In this case, the elasticity of changes in I-O multipliers will be determined
simultaneously by three factors: labor efficiency, the price of input materials, and the price
of the final product. For example, if the average room price rises from $100 to $150,
assuming the input materials still cost $33 per room and one employee supports five
occupied rooms (unchanged from the base-year level), the absolute monetary costs of
intermediate inputs and labor are unaffected, but the relative ratio of costs is reduced. This
will then lead to reduced type I sales and jobs multipliers.

Based on this example, an increase in room price and more efficient labor usage
result in reduced input costs and subsequently, a higher operating surplus. Allowing the
average salary per employee to vary creates a more complicated example. Any change in
the input factors will lead to modifications of the cost structure. The assumption of
Constant Returns to Scale (CRTS), which indicates fixed input costs, labor expenses, and
profitability in relation to sales volume, therefore introduce biases when output price, labor efficiency, and average wages vary with demand levels.

3. A case study of Taiwan tourist hotels

Data from Taiwan tourist hotels provide an empirical test of the stability of jobs and income ratios with respect to occupancy rates. The primary focus was to relax the assumption of constant value added components (jobs, income and profits) by the utilization level in the I-O model while assuming the technical input coefficients was fixed. In other words, the type I sales multiplier remained unchanged while the two economic ratios (jobs and income) and their associated multipliers are allowed to vary.

The accommodation sector in Taiwan was selected due to the following reasons. First, hotel rooms are a good example of time perishable products. The accommodation sector responds sensitively to the demand and supply changes in terms of price, labor use, and the resulting profitability. Second, the concept of capacity utilization in the accommodation sector is well defined and measurable. With data on total rooms and occupied rooms, capacity utilization of the accommodation sector can be precisely measured by room occupancy rates (Borooah, 1999).

Data. Two panel data sets, provided by the Taiwan Tourism Bureau (1999-2003b), were used in the estimation of jobs to sales ratios and income to sales ratios. The descriptive information of tourist hotels is displayed in Table 2. Econometric models were constructed to determine the relationship between occupancy rates and (1) jobs per NT$ million hotel sales, and (2) personal income per NT$ million hotel sales. Geographic location, consumer price index, and hotel scales were included as control variables in the
regression equations to account for factor differences between hotels (Liu & Var, 1982; Pan, 2005). Locations were introduced as dummy variables representing northern Taiwan, central Taiwan, southern Taiwan and eastern Taiwan. The consumer price index (Directorate-General of Budget Accounting and Statistics, 2004) was incorporated to capture changes due to general price inflation. Hotel scale was measured by the number of rooms in each establishment.

*Jobs to sales ratios.* The econometric relationship between hotel occupancy rates and jobs to sales ratios was estimated using the yearly firm level operational data for tourist hotels in Taiwan from 1999 to 2003 (Taiwan Tourism Bureau, 1999-2003a). The dataset included 361 observations representing 83 hotels over a 5-year period. Regression analysis was performed within the Statistical Package for Social Science (SPSS) and Stata using the stepwise approach. The functional form was determined by comparing adjusted R-square values across 11 functional forms (curve-estimation process in the SPSS program). Multicollinearity and autocorrelation were examined during the analysis. Corrections were performed when needed.

*Income to sales ratio.* The econometric relationship between hotel occupancy rates and personal income to sales ratios was estimated using the yearly firm level international tourist hotel financial data from 1999 to 2002 (Taiwan Tourism Bureau, 1999-2003b). A total of 221 cases (annual averages) from 59 hotels were reported over the 4-year span. The same procedure of the regression analysis, as described above, was used to analyze the relationship between income to sales ratios and occupancy rates.
3.1 Result

*Jobs to Sales Ratio.* A log linear functional form best captures the relationship between hotel jobs to sales ratios and occupancy rates. Occupancy rates and hotel scales (number of rooms) are significant in determining jobs to sales ratios at the 95% confidence level. The consumer price index and three region dummy variables are not significant (Table 3). Jobs to sales ratios are negatively correlated with occupancy rates. A rise in occupancy rate leads to fewer jobs per million sales. Due to the non-linear functional form, the percentage changes in jobs to sales ratio are not constant at different occupancy levels. A 5% increase from 80% to 85% in occupancy, for example, will lead to a smaller reduction in jobs to sales ratios than a 5% increase from 40% to 45% for tourist hotels in Taiwan.

*Personal Income to Sales Ratio.* Personal income to sales ratios are modeled as a linear function. No multicollinearity is observed in the independent variables but some level of heteroskedasticity is discovered among the error terms. Variances of the coefficients are re-calculated using the Huber-White sandwich estimation, which corrects the bias of heteroscedasticity. The correction provides larger variances (robust standard error) for the constant and occupancy rates in the equation, but the recomputed standard error does not change the significance of the independent variables.

Occupancy rates and hotel scales are significant in determining personal income to sales ratios at the 95% confidence level (Table 4). Income to sales ratios and occupancy rates are negatively correlated, indicating that a rise in the occupancy rate leads to a smaller percentage of sales going to employee compensation. For tourist hotels in Taiwan, a one
percent increase in occupancy rate would yield a decrease of 0.11 in the income to sales ratio, ceteris paribus.

With the average occupancy rate of 62% and an average 253 rooms per tourist hotel in 1999, a 5% increase in occupancy rates would lead to a 7% decrease in job ratios, and a 1.5% reduction in income ratios (Table 5). A 5% decrease in occupancy rates, on the other hand, would raise the job ratio by 8% and increase the income ratio by 1.5%.

3.2 Predicted I-O Multipliers

The predicted percentage changes for tourist hotels in Taiwan are then applied to the hotel job and income ratios in the 1999 Taiwan I-O table5. The results are displayed in Figure 2. In 1999, when the average occupancy rate was 62%, the jobs to sales ratio was 0.4972 per NT$ million sales for the accommodation sector in Taiwan. The jobs to sales ratio would rise to 0.6681 if occupancy rates decrease to 42%. The ratio would fall to 0.3436 if occupancy rates increase to 87%. The personal income to sales ratio, on the other hand, is less responsive to changes in occupancy rates, ranging between 0.38 and 0.44 over the same range of changes in occupancy.

The predicted job and income ratios with respect to occupancy rates in Figure 2 are applied to re-compute multipliers for the hotel sector in the Taiwan I-O model (Table 6). Type I sales multipliers remain constant with respect to occupancy rates, while type II sales multipliers vary by plus or minus 3% from the base year when occupancy rates fluctuate

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5 Tourist hotels are assumed to be representative for the accommodation sector in Taiwan as they account for a majority of hotel sales and workforce. In 1996, tourist hotels accounted for 4% of total accommodation entities, 70% of total employees, 60% of total sales, and 55% of total personal income in the Taiwan accommodation sector (Directorate-General of Budget Accounting and Statistics, 2003).
between 42% and 82%. The variation is due to changing income ratios (the percentage of sales goes to employee compensation) in the hotel sector, which subsequently leads to distinctive induced effects. Type I job multipliers for the hotel sector differ substantially, ranging from 1.01 jobs per NT$ million hotel sales at 42% occupancy to 0.56 jobs per NT$ million hotel sales at 82% occupancy. Given a one million visitor spending on the accommodation sector, the standard I-O model will underestimate hotel jobs by as much as 34% if, at this instance, occupancy rate is 42%, or will overestimate hotel jobs by 26% if occupancy maintains at 82%. The type I income multiplier is more stable with a maximum 6% difference from the base year figure for occupancy rate between 42% and 82%.

4. Discussion

The coefficients observed in the standard I-O table generally represent the average performance of business throughout a year. Using the standard I-O framework fundamentally assumes that there is an equality of average and marginal coefficients – the cost function would remain unchanged for offering additional units (O'Hagan & Mooney, 1983). For businesses exercising constant economies of scale, the standard I-O model provides unbiased impact estimation with respect to the scale of operation because its production function remains unchanged at different utilization levels (Table 7). For services following economies of scale, the average cost per unit is reduced when production expands (higher capacity utilization). The standard I-O model, when capacity utilization is high, will overestimate total jobs and personal income and underestimate profits. The biases arise because the standard I-O model does not reflect greater labor efficiency, reduced average cost, and substitution between capital and labors. On the other hand, when
utilization is low, businesses naturally face a much lower profit rate due to high fixed
operation cost and labor expenses. The standard I-O model, under this instance, will tend to
overstate business profits and underestimate jobs and personal income. For services
exhibiting diseconomies of scale, the biases will be in the opposite direction.

4.1 Applications

Allowing economic ratios and technical coefficients to vary should be considered
whenever the policy being evaluated causes changes in capacity utilization from the year
the I-O table represents. The problem of using a standard I-O (fixed ratios) model in
tourism is particularly evident when evaluating special events and festivals. These are
generally held for short periods, creating peaks in demand and high capacity utilization. In
these instances, the traditional I-O model will overestimate jobs and income effects and
underestimate business profits. This is because increased sales in the short run are
accommodated by greater labor efficiency as businesses exercise economies of scale. Jobs
and wage payments therefore are not increased in direct proportion to the additional sales.
As documented by Hatch (1986) in the study of the Grand Prix in Australia, profits and
value added components increased at higher utilization levels.

Economic ratios and technical coefficients should also be adjusted when evaluating
significant drops in tourism due to weather, disease outbreaks, or terrorist activities. Using
the standard I-O model in these cases will overestimate job and income losses because
firms cannot immediately reduce labor cost in proportion to reduced sales. The loss in
business profits will be greater than the predicted figure using the standard I-O model as
cost per unit sale will be above the baseline.
In evaluating long-term policies, the rate of growth in supply must be considered along with anticipated demand increases. If supply and demand expand at similar rates from the base year, capacity utilization will remain relatively constant and standard I-O models will yield unbiased impact estimates. If demand grows faster than supply, utilization rates will increase and standard I-O models will overestimate job and income effects, and vice versa.

4.2 Recommendations for future studies

Value added is only part of the production function. The case study presented in this paper focused on the changes in employment and income ratios. To obtain comprehensive insights between business operations and capacity utilization, relationships between the Leontief technical coefficients (type I sale multipliers) and capacity utilization should be included. Empirical data are needed to establish elasticity between 1) price changes and capacity utilization, and 2) intermediate input usage and capacity utilization. Given a rise in utilization, the likely pattern is an increase in output price and proportionally lower cost per unit output. These patterns would lead to reduced type I sales multipliers and larger value added components. The joint influence on the type II sales multipliers however is undetermined as it depends on the nature of each industry.

The examination of varying economic ratios should be extended to other service sectors, especially for food and beverage services, transportation, and entertainment services. These three sectors have characteristics similar to accommodations in terms of product perishability and pricing strategies. A clear definition and measurement of capacity utilization for each industry is required to quantify the relationships between capacity
utilization and the value added components. Modifying the value added components for multiple sectors simultaneously is also encouraged, so that the joint effects on the rest of the economy can be modeled.

The third perspective deserving further discussion is the flexibility of product switching and capacity creation in tourism operation, such as offering flexible flight schedules or converting ski resorts into golf courses in the summer. Service diversification, cross-training employees or creating adjustable capacity allows firms to offer multiple goods within idle capacity or when faced with a dramatic increase in demand. Governments in Taiwan, for example, eagerly promote MICE industry (Meeting, Incentive, Convention, and Exhibition) to the accommodation sector as an approach to combat seasonal demands of leisure travel. The measurement of capacity utilization of the hotel operation, therefore, goes beyond typical “occupancy rate” as lodging sales is compensated by conference and banqueting business. Considering the economic transferability of resources, there is no single standard definition of capacity utilization and the association with CU and I-O multipliers would be much more complex than suggested in this paper.

5. Conclusion

Demand fluctuation is the nature of the tourism industries. Standard I-O analysis is insufficient to reflect the changing cost structures of services due to capacity utilization. Especially in the process of tourism policy evaluation, the proposed scenarios may contain a variety of supply and demand conditions which should be evaluated from the perspective of the final demand changes as well as the resulting modification of I-O structures. The cost structure and economic ratios in the accommodation sector, for example, presented in the
Input-Output table, would be different for two consecutive years; one with an average 50% occupancy rate and the other with an average 70% while assuming other factors remain constant. The precision of estimation can be improved when these two scenarios (50% vs. 70% occupancy rate) are each applied with distinct I-O multipliers. It is therefore important to incorporate a mechanism that will reflect the market dynamics into the I-O structures in terms of price factor, input ratio, and labor efficiency based on different supply and demand levels. Under the proposed model, tourism economic impacts will then be determined simultaneously by final demand changes as well as the level of capacity utilization.

For tourism industries, one of the critical problems in impact estimates is the potential biases in analyzing short term events or policies that will change the supply/demand ratios for tourism industries. By integrating capacity utilization to the I-O model, the approach suggested here offers an intermediate level of modeling that corrects some of the biases of standard I-O models with minimal increases in complexity.

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6. References


